



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/773,187	02/09/2004	Kia Silverbrook	MTB31US	8432
24011 7590 05/24/2007 SILVERBROOK RESEARCH PTY LTD 393 DARLING STREET BALMAIN, 2041 AUSTRALIA			EXAMINER FIDLER, SHELBY LEE	
			ART UNIT 2861	PAPER NUMBER
			MAIL DATE 05/24/2007	DELIVERY MODE PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

**Office Action Summary**

Application No.

10/773,187

Applicant(s)

SILVERBROOK, KIA

Examiner

Shelby Fidler

Art Unit

2861

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 30 January 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1,4-19,22-38 and 41-54 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1,4-19,22-38 and 41-54 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | 5) <input type="checkbox"/> Notice of Informal Patent Application                       |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)<br>Paper No(s)/Mail Date <u>4/18/2007</u> . | 6) <input type="checkbox"/> Other: _____  |

## DETAILED ACTION

### *Responsive Office Action*

This Office Action is responsive to amendments/remarks filed 1/30/2007.

### *Information Disclosure Statement*

The information disclosure statement (IDS) submitted on 4/18/2007 is being considered by the examiner.

### *Claim Rejections - 35 USC § 103*

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1, 5, 11-13, 15, 19, 23-24, 30-32, 34, 38, 42, 47-48, and 50-51 are rejected under 35 U.S.C. 103(a) as being unpatentable over Campbell et al. (US 4870433) in view of Kubby (US 5706041) and Whitman (US 6213587 B1).

Regarding claims 1, 19, and 38:

Campbell et al. disclose an inkjet printhead comprising:

a plurality of nozzles (nozzles 19; col. 3, lines 1-3 and col. 2, lines 17-21) each has a nozzle aperture (Fig. 2);

Art Unit: 2861

a bubble forming chamber (print cavity 21) corresponding to each of the nozzles respectively (Fig. 2);

a heater element (resistive heater elements 12) disposed in each of the bubble forming chambers respectively (Fig. 2), the heater element having two bubble nucleation regions (elongated portions 31) in a plane parallel to that of the nozzle aperture (Fig. 2), such that a layer of an ejectable liquid is between the plane of the two bubble nucleation regions and that of the nozzle aperture (col. 3, lines 50-60 and Fig. 2), and wherein the two bubble nucleation regions are laterally offset from a central axis of the nozzle aperture (Fig. 3), the lateral offset of one of the bubble nucleation regions being equal and opposite to the lateral offset of the other bubble nucleation region (Figs. 1-3); such that

heating the heater element to a temperature above the boiling point of the bubble forming liquid forms a gas bubble (bubble 22) that causes the ejection of a drop of an ejectable liquid through the nozzle aperture corresponding to that heater element (col. 3, lines 8-13); wherein

the bubble nucleation regions are spaced from each other such that bubbles nucleated at each will grow until they unite to form the gas bubble that causes the ejection of a drop of ejectable liquid (col. 3, lines 50-60); and

supplying the nozzle with a replacement volume of the ejectable liquid equivalent to the ejected drop (obvious to the cyclic ejections of col. 3, lines 3-7 and col. 4, lines 64-68).

**Campbell et al. do not expressly disclose** that the bubble nucleating regions are suspended within the bubble forming chamber, or that the plane containing the bubble nucleation regions is less than 50 microns from the nozzle aperture.

Art Unit: 2861

**However, Kubby discloses** suspending bubble nucleating regions (doped regions 20, 22) of a heater element (col. 1, line 64 - col. 2, line 3); and

**Whitman discloses** placing a heater element (heater 24) that is less than 50 microns from a nozzle aperture (col. 8, lines 9-14 and Figs. 6).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize a suspended heater element, such as taught by Kubby, and a heater element whose bubble nucleating regions are less than 50 microns from the nozzle aperture into the invention of Campbell et al. One motivation for suspending the heater element, as taught by Kubby, is to increase the overall heat-transfer efficiency of the heating element (col. 5, lines 10-27). One motivation for placing the bubble nucleating regions in a plane less than 50 microns from the nozzle aperture, as taught by Whitman, is that reducing the barrier height, as well as reducing the power density and nozzle plate thickness, greatly improves printhead reliability (col. 15, lines 48-52).

**Regarding claims 5, 24, and 42:**

**Campbell et al. also disclose** that the bubble forming liquid and the ejectable liquid are of a common body of liquid (col. 3, lines 8-13).

**Regarding claims 11, 30, and 47:**

**Campbell et al. also disclose** that each heater element (12) has two opposite sides (top curved portion and bottom curved portion of heater element 12 in Fig. 3) and is configured such that the gas bubble (22) formed by that heater element is formed at both sides of that heater element (col. 3, lines 50-60).

**Regarding claims 12, 31, and 48:**

Campbell et al. also disclose that the bubble (20), which each heater element is configured to form, is collapsible and has a point of collapse, and wherein each heater element is configured such that the point of collapse of a bubble formed thereby is spaced from that heater element (col. 3, lines 60-66).

**Regarding claims 13, 32, and 50:**

Campbell et al. also disclose a structure (substrate 18), wherein the nozzles (19) are incorporated on the structure (col. 3, lines 1-3 and Fig. 2).

Examiner notes the limitation that the structure is formed by chemical vapor deposition. However, this limitation pertains only to the method of forming a device, which is not germane to the patentability of the device itself; therefore, Examiner has not given this limitation patentable weight.

**Regarding claims 15, 34, and 51:**

Campbell et al. also discloses a plurality of nozzle chambers, each corresponding to a respective nozzle (col. 2, lines 48-53 and Figs. 1-2).

Campbell et al. as modified by Kubby and Whitman do not expressly disclose a plurality of heater elements disposed within each chamber, the heater elements within each chamber being formed on different respective layers.

However, Kubby also discloses a plurality of heater elements (doped regions 20a & 20b) disposed within each chamber (Fig. 4), the heater elements within each chamber being formed on different respective layers (col. 4, lines 26-55).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize a plurality of heater elements disposed within each chamber, such as taught by Kubby, into the invention of Campbell et al. as modified by Kubby and Whitman.

Art Unit: 2861

One motivation for doing so, as taught by Kubby, is to provide an ink-jet ejector that is capable of emitting droplets of two distinct sizes (col. 4, lines 56-66).

**Regarding claim 23:**

**Campbell et al. also disclose supporting the bubble forming liquid that is in thermal contact with each of the heater elements, and supporting the ejectable liquid that is adjacent to each nozzle (col. 3, lines 50-60 and Fig. 2).**

Claims 4, 7, 16, 18, 22, 26, 35, 37, 41, 52, and 54 are rejected under 35 U.S.C. 103(a) as being unpatentable over Campbell et al. as modified by Kubby and Whitman, as applied to claims 1, 19, and 38 above, and further in view of Anagnostopoulos et al. (US 6502925 B2).

**Regarding claims 4, 7, 22, 26, and 41:**

**Campbell et al. as modified by Kubby and Whitman disclose all claimed limitations except that the heater elements are formed predominantly from titanium nitride.**

**However, Anagnostopoulos et al. disclose heater elements (notch type heaters) formed predominantly from titanium nitride (col. 10, lines 32-34).**

At the time of invention, it would have been obvious to a person of ordinary skill in the art to modify the heater elements of Campbell et al. as modified by Kubby and Whitman to be predominantly titanium nitride. The motivation for doing so, as taught by Chan (US 5710070), is that the titanium/titanium nitride resistive layer provides good electro-migration performance to sustain high current density at high temperatures (col. 3, lines 30-33).

**Regarding claims 16, 35, and 52:**

Art Unit: 2861

**Campbell et al. as modified by Kubby and Whitman disclose all claimed limitations except that the heater elements are formed of solid material more than 90% of which is constituted by at least one periodic element having an atomic number below 50.**

**However, Anagnostopoulos et al. disclose heater elements formed of solid material more than 90% of which is constituted by at least one periodic element, having an atomic number below 50 (Ti and TiN, col. 10, lines 31-33).**

At the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize heater elements formed of Titanium and Titanium Nitride into the invention of Campbell et al. as modified by Kubby and Whitman. The motivation for doing so, as taught by Chan (US 5710070), is that the titanium/titanium nitride resistive layer provides good electro-migration performance to sustain high current density at high temperatures (col.3, lines 30-33).

**Regarding claims 18, 37, and 54:**

**Campbell et al. as modified by Kubby and Whitman disclose all claimed limitations except that the heater elements have a conformal protective coating on any parts exposed to the bubble forming liquid, wherein the coating of each heater element is applied substantially to all sides of the heater element such that the coating is seamless.**

**However, Anagnostopoulos et al. disclose heater elements have a conformal protective coating (passivation layer) on any parts exposed to the bubble forming liquid, wherein the coating of each heater element is applied substantially to all sides of the heater element such that the coating is seamless (col. 10, lines 33-39 and Figs. 5 and 15).**

Examiner notes the additional limitation that the protective coating is applied simultaneously. However, this limitation pertains only to the method of forming a device,



Art Unit: 2861

which is not germane to the patentability of the device itself; therefore, Examiner has not given this limitation patentable weight.

At the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize a protective coating applied substantially to all sides of the heater element into the invention of Campbell et al. as modified by Kubby and Whitman. The motivation for doing so, as taught by Anagnostopoulos et al., is to protect the heater from the corrosive action of the ink (col. 10, lines 35-37).

Claims 6, 8, 10, 14, 25, 27, 29, 33, 43, 44, 46, and 49 are rejected under 35 U.S.C. 103(a) as being unpatentable over Campbell et al. as modified by Kubby and Whitman, as applied to claims 1, 19, and 38 above, and further in view of Silverbrook (US 6019457).

**Regarding claims 6, 25, and 43:**

**Campbell et al. as modified by Kubby and Whitman disclose all claimed limitations except that the printhead is a page-width printhead.**

**However, Silverbrook discloses a pagewidth printhead (head 200) configured to print on a page (col. 6, lines 7-12).**

At the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize a pagewidth printhead into the invention of Campbell et al. as modified by Kubby and Whitman. The motivation for doing so, as taught by Silverbrook, is to be able to print on the width of an A4 page (col. 6, lines 7-12).

**Regarding claims 8, 27, and 44:**

**Campbell et al. as modified by Kubby and Whitman disclose all claimed limitations except that the heater elements are configured such that an actuation energy of less than 500 nJ**

Art Unit: 2861

is required to heat the heater element sufficiently to form the bubble in the bubble forming liquid, thereby causing an ejection of the drop.

However, Silverbrook discloses heater elements (heaters 120; Fig. 10) that are configured such that an actuation energy of less than 500 nJ is required to heat the heater element sufficiently to form the bubble in the bubble forming liquid, thereby causing an ejection of the drop (200 nJ; col. 19, lines 8-9).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize heater elements that require less than 500 nJ to heat the heater element to eject a drop into the invention of Campbell et al. as modified by Kubby and Whitman. The motivation for doing so, as taught by Silverbrook, is to allow power dissipation to be reduced without affecting print speed (col. 19, lines 9-10).

Regarding claims 10, 29, and 46:

Campbell et al. as modified by Kubby and Whitman disclose all claimed limitations except that the substrate surface has an areal density of nozzles exceeding 10,000 nozzles per square centimeter of substrate surface.

However, Silverbrook discloses a substrate surface wherein the areal density of the nozzles relative to the substrate surface exceeds 10,000 nozzles per square centimeter of substrate surface (using the reference measurement of Figure 43 and counting the individual nozzles disclosed in the "part of cyan" section of Figure 43, calculations show that the density exceeds 10,000 per square centimeter:  $\frac{20 \text{ nozzles}}{0.0016384 \text{ cm}^2} = 12207 \frac{\text{nozzles}}{\text{cm}^2}$ ).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize a printhead substrate surface with a nozzle density of 10,000 nozzles per square

Art Unit: 2861

centimeter into the invention of Campbell et al. as modified by Kubby and Whitman. The motivation for doing so, as taught by Silverbrook, is to provide four nozzles per pixel which would give up to 16 drops per pixel (co. 16, lines 60-62).

**Regarding claims 14, 33, and 49:**

Campbell et al. also disclose that the printhead has a structure (substrate 18), wherein the nozzles (19) are incorporated on the structure (col. 3, lines 1-3 and Fig. 2).

Campbell et al. as modified by Kubby and Whitman do not expressly disclose that the structure is less than 10 microns thick.

However, Silverbrook discloses a structure (overcoat 142) that is less than 10 microns thick (col. 9, lines 8-10), wherein nozzles are incorporated on the structure (Fig. 11).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize a structure incorporating nozzles that is less than 10 microns thick into the invention of Campbell et al. as modified by Kubby and Whitman. The motivation for doing so, as taught by Silverbrook, is to provide increased levels of protection against the air (col. 9, lines 5-8).

Claims 9, 28, and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Campbell et al. as modified by Kubby and Whitman, as applied to claims 1, 19, and 38 above, and further in view of Hara et al. (US 4376945).

**Regarding claims 9, 28, and 45:**

Campbell et al. as modified by Kubby and Whitman disclose all claimed limitations except that the printhead is configured to receive a supply of the ejectable liquid at an ambient temperature, wherein each heater element is configured such that the energy required to be

Art Unit: 2861

applied to heat the heater element to cause the ejection of the drop is less than the energy required to heat a volume of the ejectable liquid equal to the volume of the drop, from a temperature equal to the ambient temperature to the boiling point.

However, Hara et al. disclose a printhead (recording heat 109) configured to receive a supply of the ejectable liquid (ink 114) at an ambient temperature (room temperature), wherein the heater elements are configured such that the energy required to be applied to heat the heater elements to cause the ejection of the drop is less than the energy required to heat a volume of the ejectable liquid equal to the volume of the drop, from a temperature equal to the ambient temperature to the boiling point (col. 31, lines 19-21, 26-29; preheating means keeps the temperature in the chamber only 2-3 degrees below boiling, thus requiring less energy to eject a droplet).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize preheating means into the invention of Campbell et al. as modified by Kubby and Whitman. The motivation for doing so, as taught by Hara et al., is so that the heat energy of a recording signal effectively serves to form ink droplets and to improve energy efficiency (col. 30, lines 12-17).

Claims 17, 36, and 53 are rejected under 35 U.S.C. 103(a) as being unpatentable over Campbell et al. as modified by Kubby and Whitman, as applied to claims 1, 19, and 38 above, and further in view of DeMoor et al.

**Regarding claims 17, 36, and 53:**

Campbell et al. as modified by Kubby and Whitman disclose all claimed limitations except that the heater elements are configured for a mass of less than 10 nanograms to be heated to cause ejection of a drop.

However, DeMoor et al. disclose heater elements configured for a mass of less than 10 nanograms to be heated (page 285, Fabrication: Ti thickness = 5nm; TiN thickness = 30nm; heater width = 2000 $\mu$ m; heater width = 0.4 $\mu$ m. Therefore, the volume of Ti within the heater is  $4 \times 10^{-12}$  cm<sup>3</sup>, and the volume of TiN within the heater is  $2.4 \times 10^{-11}$  cm<sup>3</sup>. Using the known densities of Ti = 4.54 g/cm<sup>3</sup> and TiN = 5.22 g/cm<sup>3</sup>, the heater element has an entire mass of 0.14344 ng).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize De Moor et al.'s heater element mass into the invention of Silverbrook as modified by Campbell et al. as modified by Kubby and Whitman. The motivation for doing so, as taught by De Moor et al., is that these types of heaters show excellent resistivity uniformity and a low TCR value (page 293, Conclusions).

#### *Response to Arguments*

Applicant's arguments with respect to claims 1, 19, and 38 have been considered but are moot in view of the new ground(s) of rejection. Please see the above combination of Campbell et al. as modified by Kubby and Whitman, which discloses a heater element having two bubble nucleation regions that are suspended within the bubble forming chamber in a plane parallel to and less than 50 microns from that of the nozzle aperture such that, in use, a layer of an ejectable liquid is between the plane of the two bubble nucleation regions and that of the nozzle aperture.

*Conclusion*

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

*Communication with the USPTO*

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shelby Fidler whose telephone number is (571) 272-8455. The examiner can normally be reached on M-F 8:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Luu can be reached on (571) 272-7663. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

*Shelby Fidler 5/22/2007*

Shelby Fidler  
Patent Examiner  
AU 2861



**MATTHEW LUU**  
**SUPERVISORY PATENT EXAMINER**